

## VU Research Portal

### **Study protocol of a cluster randomised controlled trial investigating the effectiveness of a tailored energy balance programme for recent retirees.**

Werkman, A.; Schuit, A.J.; Kwak, L.; Kremers, S.P.J.; Visscher, T.L.S.; Kok, F.J.; Schouten, E.G.

#### ***published in***

BMC Public Health  
2006

#### ***DOI (link to publisher)***

[10.1186/1471-2458-6-293](https://doi.org/10.1186/1471-2458-6-293)

#### ***document version***

Publisher's PDF, also known as Version of record

[Link to publication in VU Research Portal](#)

#### ***citation for published version (APA)***

Werkman, A., Schuit, A. J., Kwak, L., Kremers, S. P. J., Visscher, T. L. S., Kok, F. J., & Schouten, E. G. (2006). Study protocol of a cluster randomised controlled trial investigating the effectiveness of a tailored energy balance programme for recent retirees. *BMC Public Health*, 6, 293. <https://doi.org/10.1186/1471-2458-6-293>

#### **General rights**

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal ?

#### **Take down policy**

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

#### **E-mail address:**

[vuresearchportal.ub@vu.nl](mailto:vuresearchportal.ub@vu.nl)

Study protocol

Open Access

## Study protocol of a cluster randomised controlled trial investigating the effectiveness of a tailored energy balance programme for recent retirees

Andrea Werkman<sup>1,2</sup>, Albertine J Schuit<sup>2</sup>, Lydia Kwak<sup>3</sup>, Stef PJ Kremers<sup>4</sup>, Tommy LS Visscher<sup>5</sup>, Frans J Kok<sup>1</sup> and Evert G Schouten<sup>\*1</sup>

Address: <sup>1</sup>Division of Human Nutrition, Wageningen University, PO Box 8129, 6700 EV, Wageningen, the Netherlands, <sup>2</sup>National Institute for Public Health and the Environment, PO Box 1, 3720 BA, Bilthoven, the Netherlands, <sup>3</sup>Department of Human Biology, Maastricht University, PO Box 616, 6200 MD, Maastricht, the Netherlands, <sup>4</sup>Department of Health Education and Promotion, Maastricht University, PO Box 616, 6200 MD, Maastricht, the Netherlands and <sup>5</sup>Institute for Health Sciences, Vrije Universiteit, De Boelelaan 1085, 1081 HV, Amsterdam, the Netherlands

Email: Andrea Werkman - [andrea.werkman@wur.nl](mailto:andrea.werkman@wur.nl); Albertine J Schuit - [jantine.schuit@rivm.nl](mailto:jantine.schuit@rivm.nl); Lydia Kwak - [l.kwak@hb.unimaas.nl](mailto:l.kwak@hb.unimaas.nl); Stef PJ Kremers - [s.kremers@gvo.unimaas.nl](mailto:s.kremers@gvo.unimaas.nl); Tommy LS Visscher - [tommy.visscher@falw.vu.nl](mailto:tommy.visscher@falw.vu.nl); Frans J Kok - [frans.kok@wur.nl](mailto:frans.kok@wur.nl); Evert G Schouten\* - [evert.schouten@wur.nl](mailto:evert.schouten@wur.nl)

\* Corresponding author

Published: 06 December 2006

Received: 10 October 2006

BMC Public Health 2006, 6:293 doi:10.1186/1471-2458-6-293

Accepted: 06 December 2006

This article is available from: <http://www.biomedcentral.com/1471-2458/6/293>

© 2006 Werkman et al; licensee BioMed Central Ltd.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/2.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

### Abstract

**Background:** People in transitional life stages, such as occupational retirement, are likely to gain weight and accumulate abdominal fat mass caused by changes in physical activity and diet. Hence, retirees are an important target group for weight gain prevention programmes, as described in the present paper.

**Methods/Design:** A systematic and stepwise approach (Intervention Mapping) is used to develop a low-intensity energy balance intervention programme for recent retirees. This one-year, low-intensity multifaceted programme aims to prevent accumulation of abdominal fat mass and general weight gain by increasing awareness of energy balance and influencing related behaviours of participants' preference. These behaviours are physical activity, fibre intake, portion size and fat consumption. The effectiveness of the intervention programme is tested in a cluster randomised controlled trial. Measurements of anthropometry, physical activity, energy intake, and related psychosocial determinants are performed at baseline and repeated at 6 months for intermediate effect, at 12 months to evaluate short-term intervention effects and at 24 months to test the sustainability of the effects.

**Discussion:** This intervention programme is unique in its focus on retirees and energy balance. It aims at increasing awareness and takes into account personal preferences of the users by offering several options for behaviour change. Moreover, the intervention programme is evaluated at short-term and long-term and includes consecutive outcome measures (determinants, behaviour and body composition).

## Background

This study is performed as part of the Netherlands Heart Foundation 'Netherlands Research programme for weight Gain prevention' (NHF-NRG). This multidisciplinary programme aims to gain insight into behavioural determinants of weight gain and to identify potentially effective methods and strategies for the prevention of weight gain in distinct target groups: adolescents, young adults and recent retirees [1].

Overweight and obesity are associated with chronic conditions such as diabetes, hypertension, cardiovascular diseases and certain types of cancer, and thus considered a major public health concern [2]. Many attempts have been made to treat overweight and obesity and although these attempts show short term weight loss in most subjects, weight is often regained after cessation of the intervention [3,4]. Therefore, it has been suggested that prevention of weight gain in the general population may be a more effective strategy for addressing the overweight and obesity epidemic [5-11]. However, studies testing weight gain prevention programmes among adults are limited and often not successful. A review by Hardeman *et al* [12] regarding interventions to prevent weight gain shows that the interventions exhibited various degrees of effectiveness. Furthermore, it is not clear what elements of the interventions are associated with increased effect size, since only one of the five studies that involved an RCT design reports a significant effect on weight. The authors plead for more objective measures of physical activity and diet in future studies and for longer periods of follow-up [12].

Programmes to prevent weight gain should focus on the balance between physical activity and energy intake from foods, also referred to as energy balance [13]. Target groups are segments of the population at elevated risk of weight gain. These are often populations going through transitional life stages [1,10,14], leading to changes in daily routine. Occupational retirement is such a transitional life stage. Retirees lack work-related physical activity, which may not be compensated after retirement. Moreover, they have increased access to food and more opportunity for eating. Since, apart from retirement, ageing itself can also lead to increased fat mass and to decreased skeletal muscle mass [15,16], retirees are an important group for weight gain prevention.

This paper presents the development of the intervention programme and the study design of the cluster randomised controlled trial, called the Wageningen Approach against fat Accumulation and weight Gain (WAAG-Study). The main aim of the programme is to prevent weight gain, in particular accumulation of abdominal fat mass in recent retirees by increasing awareness of

energy balance and subsequently adapting energy balance-related behaviours according to participants' preferences.

## Methods/Design

### **Participants and recruitment**

Participants for this study are recruited from pre-retirement workshops offered by employers to approximately 10% of Dutch retirees. During such a five-day workshop several topics are discussed in order to prepare retirees for the new phase in life, e.g. changes in the household after retirement, health and vitality, and their new role in society. Inclusion criteria for the present study are: age between 55–65 years, recently retired, defined as maximal six months before or after date of retirement at inclusion, apparently healthy and not undergoing any medical treatment that might affect the outcome measures. Written informed consent from participants is obtained upon enrolment. The study protocol is approved by the Medical Ethics Committee of Wageningen University.

### **Study design**

We randomise all participants from one workshop together rather than individually because we fear adoption of the intervention programme by individuals in the control group. Thus, clusters of workshop participants are allocated to either the intervention or control group. Allocation is performed the week following baseline examination by an independent person and taking into account the number participants per workshop and the number of included clusters per week.

We hypothesise that waist circumference in the control group will increase with 0.5 cm per year (standard deviation = 1.3 cm) while it will remain stable among subjects in the intervention group. This is based on data obtained from a middle-aged (56–65 years) Dutch population from the 'Doetinchem Cohort' (National Institute for Public Health and the Environment, Bilthoven, the Netherlands). Calculations reveal a sample size of a total of 400 individuals, taking into account 80% power, cluster randomisation [17] with an estimated design effect of 20% [18] and assuming a drop out of 25%.

### **Theoretical basis of the intervention programme**

The intervention programme is developed according to the Intervention Mapping protocol that facilitates a systematic, stepwise process of designing health behaviour interventions [19]. Basically, it comprises of a needs assessment of the study population, an inventory of factors that influence health behaviour, a definition of the main aim, a subdivision into practicable behaviours, a linkage to determinants of behaviour, a translation into methods and practical strategies and the development of a detailed program plan.

The main aim of the intervention programme is to prevent weight gain and in particular accumulation of abdominal fat mass. Practicable intermediate steps to reach this aim are increased awareness of energy balance and related behaviours and subsequently prevention of unfavourable change in diet and/or physical activity. For the purpose of intelligibility, energy balance is defined as the equilibrium between energy intake from the diet and energy expenditure from physical activity. Specific energy balance-related behaviours that are identified for the present study are depicted in figure 1 and elucidated below.

The intervention programme focuses on two domains of physical activity: daily routine physical activity and recreational/sport activities. Daily routine physical activity is of importance, since retirees lack work-related physical activity that may not be compensated after retirement. Therefore, retirees need to be aware of opportunities for daily physical activity, such as household activities and active transportation [20,21]. Furthermore, retirees have more time available and thus recreational and sport activities, e.g. bicycling and walking, are also incorporated in the programme.

Two strategies related to energy-density are included in the programme: replacement of high-fat foods with low-fat foods [22-27] and replacement of low-fibre foods with high-fibre foods [26,28-31]. The intervention programme also focuses on the reduction of portion sizes of energy dense foods during the main meals of the day and during snacking [32,33].

The behaviours mentioned above are further linked to their matching psychosocial determinant: knowledge, awareness, attitude, perceived self-efficacy, and habit. In our study, knowledge is further subdivided in nutritional knowledge [34], knowledge of fibre-rich products [35] and knowing health benefits of a healthy diet and physical activity. Previous studies have shown that increasing awareness of personal physical activity and dietary behav-

iours is important [36,37] as well as attitude [38-41]. Furthermore, perceived self-efficacy has been shown to be a predictor for the consumption of fruits, vegetables and low fat diets [42] and may affect the consumption of large portion sizes [43]. Finally, habit is a factor that needs to be taken into account, since dietary behaviour has often become a habit since childhood [38,44,45] and it may also influence behavioural choices regarding physical activity [46,47].

#### **Intervention materials**

Based on the linkage of determinants of energy balance-related behaviour to methods and strategies, existing materials are identified and new materials are developed. This resulted in our energy balance programme, that has a low-intensity, multifaceted character and is disseminated to the intervention group over a period of one-year (see table 1 for a detailed description of the programme). Figure 2 shows the moments of distribution of the materials. The first element in the programme is a toolbox that contains an instruction leaflet and several instruments to increase awareness and knowledge of personal status of physical activity, dietary intake and weight. The second element is a CD-ROM that contains stage-matched computer tailored feedback on current energy balance status. This feedback also incorporates attitude and self-efficacy [48,49]. The outcome of the test and/or personal preference can be employed in the subsequent element, a second CD-ROM. This also contains a computer tailored programme and offers four different options for feedback on personal behaviour:

1. Feedback on total physical activity, including daily routine and sport activities;
2. Feedback on fibre intake;
3. Feedback on portion sizes of energy dense foods (hot or cold meals, snacks or beverages);

- Participants are aware of the concept Energy Balance, its role in remaining at a stable body weight and their personal energy balance status.
- Participants remain in energy balance after retirement by either:
  - Remain or increase routine activities of the daily living (lifestyle physical activity)
  - Remain or increase recreational and sports activities
  - Remain or decrease energy density of consumed foods by either:
    - Replacing high-fat products with low-fat products or
    - Replacing low-fibre products with high-fibre products
  - Remain or reduce portion sizes of energy dense foods in main meals and snacks

**Figure 1**  
Programme objectives of the intervention programme.

**Table 1: Personal determinants, methods and description of materials provided to the intervention group.**

Personal determinants	Methods	Strategies	Description
Awareness of own EBRBs <sup>1</sup> and of interaction between EBRBs <sup>1</sup>	Self-monitoring/self-evaluation; Feedback; Prompt; Information delivery.	Tools for personal evaluation; Active learning strategy.	<b>Box</b> (20*20*2.5 cm), sent by post: Instruction leaflet including a diary for activities and diet; Pedometer (advice to take 10.000 steps per day) <sup>2</sup> ; Waist tape <sup>3</sup> to assess waist circumference, with colour indication; Instrument to easily assess the BMI; Fruit & vegetable consumption self-test, scratch test format <sup>3</sup> ; Fat consumption self-test, scratch test format <sup>3</sup> ; Calorie guide to provide information on the balance between calories of several food products and exercise (minutes walking, swimming and bicycling) <sup>4</sup> .
Knowledge of (own) EBRBs <sup>1</sup> .	Information delivery; Feedback; Individualised messages.	Internet.	Study website: • General information and more comprehensive information (after login) on diet, physical activity and the trial. • Access for 6 months to the Weight Co@ch <sup>5</sup> , an interactive web-based programme providing goal setting on diet and/or physical activity based on individually assessed outcomes [50].
Knowledge of own BMI and standards; Positive attitude and high self-efficacy expectation with regard to weight gain prevention; Habit formation with regard to weight gain prevention.	Confrontation with personal risk; Individualised messages; Decisional balance; Skill training; Goal-setting.	Computer tailoring.	CD-ROM I, sent by post, including manual: Stage-matched feedback on BMI and statements on EBRB (yes/no), e.g. "Do you consciously watch less television to use that time to be physically active?" Note that it is stressed not to lose more than 5–10% of initial body weight, unless a physician is consulted.
Knowledge of own EBRBs <sup>1</sup> ; Positive attitude and high self-efficacy expectations towards EBRBs <sup>1</sup> ; Habit formation with regard to EBRBs <sup>1</sup> .	Feedback; Individualised messages; Decisional balance; Skill training; Goal-setting.	Computer tailoring.	CD-ROM II, sent by post, including manual. All feedback is provided in relation to the guidelines for the behaviour. <b>Physical activity:</b> minutes per week, based on frequency and duration [65]. <b>Fat consumption:</b> fat score based on fat consumption at cold and hot meals and snacks [66]. <b>Fibre consumption</b> based on consumption and preference for whole grain foods, fruits and vegetables. <b>Portion sizes</b> of energy dense foods during cold and hot meals, snacks and beverages. Photographs from the EPIC study are used to indicate different portion sizes with permission [67, 68]

<sup>1</sup>EBRBs = energy balance-related behaviours; <sup>2</sup>type WAI01 (Oregon Scientific); <sup>3</sup>Netherlands Nutrition Centre, The Hague, the Netherlands;

<sup>4</sup>Netherlands Heart Foundation; <sup>5</sup>Weight Co@ch is obtained from TNO Quality of Life.

#### 4. Feedback on fat intake (hot or cold meals, snacks).

Thus, participants can choose to receive individual feedback on one or more options. The feedback consists in all cases of a letter that states the current status compared to the norm (e.g. the norm for fat intake in the Netherlands, or minutes of physical activity per day). Participants can print this letter and can also choose to formulate an action plan for physical activity and can use the low-fat recipes that are available on the second CD-ROM.

Apart from the tool box and CD-ROMs, participants of the intervention group receive printed newsletters with information on the study and encouragements and prompts to use the materials and choose another option from the second CD-ROM. They also have access to the study's website, with login facilities for additional information and the Weight Co@ch, an interactive programme developed by TNO Quality of Life [50].

Subjects of the control group receive newsletters with general information only, e.g. announcements for art exhibitions and have limited access to the website.

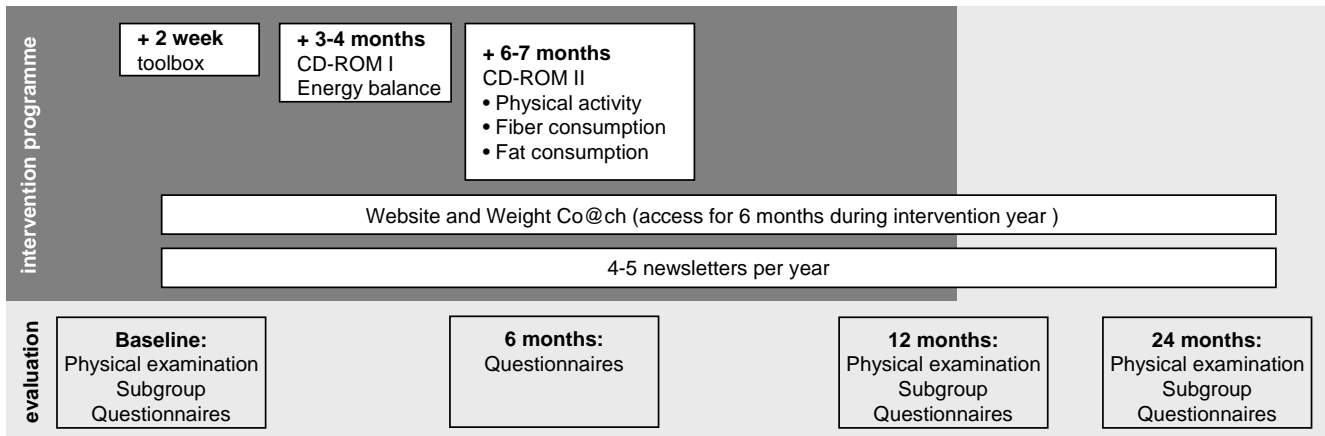
#### Outcome measurements

The effectiveness of the intervention programme is evaluated as shown in figure 2 using various consecutive outcomes as depicted in figure 3. In brief, data on body composition, blood pressure, diet and physical activity are collected at all four periods, whereas data on psychosocial determinants are gathered at baseline and after 6 and 12 months only. More details about the measurements are provided below.

#### Questionnaires

At baseline, data on demographical factors, such as education, date of retirement, and marital status are collected, as well as information on perceived health, smoking habits, use of hormone replacement therapy for women and drug use for high cholesterol levels, high blood pressure and diabetes mellitus.

Psychosocial determinants are assessed for all five identified behaviours (see figure 1) separately. Attitude, social support, norms and pressure, and self-efficacy expectations are determined based on commonly used constructs of the cognitive factors from the Theory of Planned Behav-



**Figure 2**  
Overview of the intervention programme (dark grey box) and timeline of the evaluation plan (bottom part).

your [51]. Intention to change and the stage of change for the five behaviours are also assessed; the assignment to stage of change being based on a combination of the Precaution Adoption Process Model [52,53] and the TransTheoretical Model [54]. Habit strength is assessed based on the Self-Report Habit Index [55] using three indicators of habit.

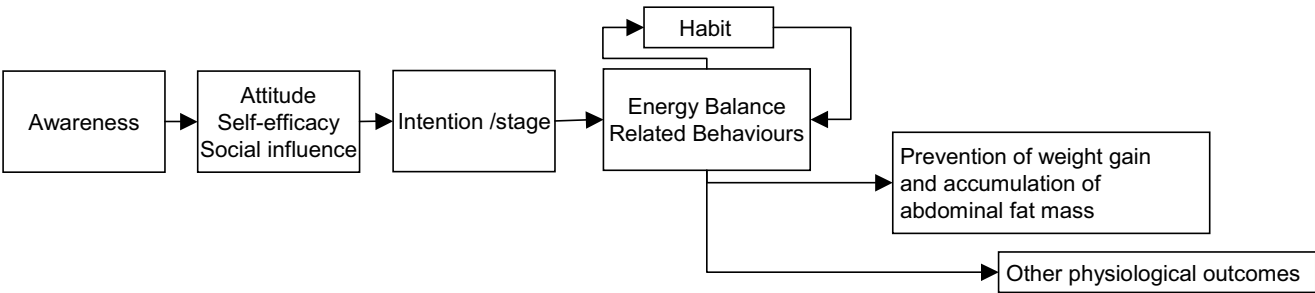
Data on dietary intake are collected using a self-administered semi-quantitative Food Frequency Questionnaire [56]. From these data total energy intake, total fat intake, saturated, mono- and poly-unsaturated fatty acids, cholesterol, total protein, total carbohydrate and alcohol consumption are derived. Fruit and vegetable intake (gram/day) is used to approximate fibre consumption. Portion size for energy dense foods is calculated as number of servings divided by the frequency of consumption.

Physical activity is assessed using the self-administered Dutch version of the Physical Activity Scale for the Elderly (PASE) [57]. The PASE assesses physical activity in the pre-

vious week in older people (aged 65–100 years) and specifically includes activities of the daily living, such as household activities [57,58]. The questionnaire assesses frequency and duration of activities at several intensities resulting in the PASE score that ranges from 0–400 with higher scores indicating greater activity levels [58].

The process evaluation is based on Rogers' diffusion of innovations-model [59] and data are collected at all follow-up measurements by using questionnaires monitoring the intervention delivery, participation, comprehension, satisfaction, level of use, and fidelity.

**Anthropometry**  
Baseline physical examinations are conducted at the location of the pre-retirement workshops. Immediately after the one-year intervention participants are re-examined. To test the sustainability of the effects participants are measured again one year after the cessation of the intervention programme (see top part figure 2). Follow-up examinations are mostly performed at community health centres



**Figure 3**  
Evaluation plan (adapted from Kremers et al, 2005 [1] with permission). The intervention programme also involves awareness, attitude, self-efficacy, social influence, intention to change and energy balance related behaviours.

throughout the Netherlands, at the same time of day and by the same researcher compared to baseline.

Physical examinations are conducted between 11.00 am and 2.00 pm with participants wearing underwear only. Body weight is measured to the nearest 0.2 kg with an electric weigh-beam (SECA 840 scale & SECA 888; Vogel & Halke GmbH & Co KG, Hamburg, Germany) and body height to the nearest 0.1 cm with a mobile stadiometer (SECA 225; Vogel & Halke GmbH & Co KG, Hamburg, Germany). Waist circumference is measured at the mid-point between the lower rib and the iliac crest, hip circumference at the trochanter level, and thigh circumference immediately below the gluteal fold, upper arm circumference at the midst between the acromion and olecranon and calf circumference between the knee and ankle malleoli, with the leg at a 90° angle. Circumferences are measured twice to the nearest 0.1 cm with a plastic measuring tape. These anthropometric measurements are taken with participants in an upright position. Abdominal sagittal diameter is measured twice at the midst between the lower rib and iliac crest with participants in a supine position.

#### *Body composition*

Total body water is assessed by bioelectrical impedance measurements at 100 kHz by a tetra-polar, single-frequency device (BCM Controller, Data Input, Frankfurt, Germany) from which percentage total body fat is derived. In a subgroup randomly assigned from the clusters (at least  $n = 80$ , based on an additional sample size calculation using Fisher's transformation to determine  $p > 0.5$ ) extended examinations are performed. Skinfold thickness are determined at the sites of biceps, triceps, sub scapula and supra iliaca. Total body scans are made using Dual Energy X-ray Absorptiometry (Lunar Radiation Corporation, Madison, WI, USA) from which relative amounts of fat in the abdominal region are derived.

#### *Blood pressure*

Blood pressure is assessed twice as an indicator of general health status, with participants in a supine position, using an automatic device (Omron).

#### *Statistical analysis*

Analyses will be based on the intention-to-treat principle. Because of the cluster randomisation, we will use multi-level analyses (SAS PROC MIXED), with cluster as the random intercept. Baseline values of the dependent variable will be included as covariates. Furthermore, we plan to perform secondary analyses to explore intervention effects in subgroups of gender, education, body fatness and activity at latest job [60-62]. Finally, adherence to the intervention, defined as the self-reported use of the intervention materials (range 0-5), may be related to the outcome measures.

## **Discussion**

This study protocol presents the development of a low-intensity, multifaceted individually tailored energy balance programme and presents the design of the cluster randomised controlled trial to test the effectiveness of the programme. The intervention programme aims to prevent weight gain and in particular accumulation of abdominal fat mass in recent retirees. The content of the programme focuses on increasing awareness of energy balance and subsequently adapting behaviours according to participants' preferences.

To our knowledge, this intervention programme is unique because it applies energy balance strategies to a population of recently retired people. This population is particularly at risk for changes in daily routine physical activity and diet, because they leave the work force. If these changes are unfavourable they may lead to excessive body weight and accumulation of body fat. This is detrimental in a population that already has an elevated absolute risk of chronic diseases, such as diabetes mellitus and cardiovascular diseases [63]. Therefore, this programme may eventually reduce the risk for chronic diseases, resulting in a reduction of unhealthy life years and health care costs [64].

With respect to the development of intervention programme, some considerations should be made. First, we did not always have access to data representing the determinants of diet and physical activity of our target population. Instead we used information that was either valid for the total adult population or for the general middle-aged population. Furthermore, the intervention programme focuses on prevention of accumulation of abdominal fat and preserving muscle mass and not on reducing body weight. Ageing itself may lead to loss of muscle mass and gain of fat mass [15,16] and we wanted to avoid that participants would lose too much body weight, which may have negative effects at older age [63]. Thus, the programme stresses that those intending to lose large amounts of body weight should consult their physician, and that overweight participants should not lose more than 5-10% of initial body weight.

Positive aspects of the intervention programme are that it covers both diet and physical activity, offers multiple feedback options instead of a 'one-size fits all' approach and is of low-intensity, all of which may benefit compliance [1].

In our study we focus on a sequence of consecutive outcome measurements. The main outcome is abdominal fat mass, which is measured by waist circumference and in a subgroup by Dual-Energy X-ray Absorptiometry. To estimate changes in muscle mass, we assess calf and upper-arm circumference. Since the menopause affects changes

in body composition with ageing among females we collect data on menopausal status by questionnaire to be able to account for this.

We use questionnaires to evaluate the effects of the programme on dietary and physical activity behaviour. The advantage of questionnaires is that they are easily applicable in larger scale studies. To evaluate changes in physical activity, we use the Physical Activity Scale for the Elderly (PASE) [58]. The PASE is developed for an older age group and assesses household activities, daily activities and leisure time physical activity. The questionnaire is validated in Dutch older persons and the validity is moderate. To evaluate energy intake and total fat intake, we use a food frequency questionnaire validated for energy intake and fat intake [56]. To estimate changes in fibre we will use fruit and vegetables consumption and to approximate changes in portions, we will use the number of servings per months.

To conclude, transition to retirement seems a proper occasion to intervene with an energy balance programme. Such a programme may contribute to slowing down the increasing trend of overweight among retirees. Results from the trial are expected in 2007 and if effective and sustainable, the programme will be implemented in order to reach all 100,000 retirees per year in the Netherlands.

### Competing interests

The author(s) declare that they have no competing interests.

### Authors' contributions

AW, AJS, FJK and EGS are the principal investigators of the study, developed the concept and the design of the study. AW and JS drafted the manuscript. LK, TLSV and SPJK contributed to the design and content of the intervention programme. All authors read and approved the final manuscript.

### Acknowledgements

This study is supported by a grant of the Netherlands Heart Foundation (2000T005). The authors thank Cindy de Jongh, Inge Verhoeven, Els Siebelink, Dr Jeanne de Vries and Saskia Meyboom, Prof Jacob C Seidell, Dr Annette Stafleu for their co-operation.

### References

- Kremers SPJ, Visscher TLS, Brug J, Chin A Paw MJM, Schouten EG, Schuit AJ, Seidell JC, Van Baak MA, Van Mechelen W, Kemper HCG, et al.: **Netherlands Research programme weight Gain prevention (NHF-NRG): rationale, objectives and strategies.** *Eur J Clin Nutr* 2005, **59**:498-507.
- Kim S, Popkin BM: **Commentary: Understanding the epidemiology of overweight and obesity-a real global public health concern.** *Int J Epidemiol* 2006, **35**:60-67.
- Anderson JW, Konz EC, Frederich RC, Wood CL: **Long-term weight-loss maintenance: a meta-analysis of US studies.** *Am J Clin Nutr* 2001, **74**:579-584.
- Wing RR, Hill JO: **Successful weight loss maintenance.** *Annu Rev Nutr* 2001, **21**:323-341.
- Fogelholm M, Kukkonen-Harjula TK: **Does physical activity prevent weight gain - a systematic review.** *Obes Rev* 2000, **1**:95-111.
- Astrup A: **Healthy lifestyles in Europe: prevention of obesity and type II diabetes by diet and physical activity.** *Public Health Nutr* 2001, **4**(2B):499-515.
- Hill JO, Peters JC: **Environmental contributions to the obesity epidemic.** *Science* 1998, **280**:1371-1374.
- Pi-Sunyer X: **A clinical view of the obesity problem.** *Science* 2003, **299**:859-860.
- Davey RC, Stanton R: **The obesity epidemic: too much food for thought?** *Br J Sports Med* 2004, **38**:360-363.
- Carraro R, Garcia Cebrian M: **Role of prevention in the contention of the obesity epidemic.** *Eur J Clin Nutr* 2003:S94-S96.
- Mullis RM, Blair SN, Aronne LJ, Bier DM, Denke MA, Dietz W, Donato KA, Drewnowski A, French SA, Howard BV, et al.: **Prevention Conference VII: Obesity, a Worldwide Epidemic Related to Heart Disease and Stroke: Group IV: Prevention/Treatment.** *Circulation* 2004, **110**:e484-e488.
- Hardeman W, Griffin S, Johnston M, Kinmonth AL, Wareham NJ: **Interventions to prevent weight gain: a systematic review of psychological models and behaviour change methods.** *Int J Obesity* 2000, **24**:131-143.
- Webber J: **Energy balance in obesity.** *Proc Nutr Soc* 2003, **62**:539-543.
- Gill T, King L, Caterson I: **Obesity prevention: Necessary and possible. A structured approach for effective planning.** *Proc Nutr Soc* 2005, **64**:255-261.
- St-Onge MP: **Relationship between body composition changes and changes in physical function and metabolic risk factors in aging.** *Curr Opin Clin Nutr* 2005, **8**:523-528.
- Ritz P: **Factors affecting energy and macronutrient requirements in elderly people.** *Public Health Nutr* 2001, **4**:561-568.
- Campbell MK, Elbourne DR, Altman DG: **CONSORT statement: extension to cluster randomised trials.** *Brit Med J* 2004, **328**:702-708.
- Wears RL: **Advanced statistics: Statistical methods for analyzing cluster and cluster-randomized data.** *Acad Emerg Med* 2002, **9**:330-341.
- Bartholomew LK, Parcel GS, Kok G, Gottlieb NH: **Intervention Mapping. Designing theory- and evidence-based health promotion programs** New York: McGraw-Hill; 2000.
- Kumanyika S, Jeffery RW, Morabia A, Ritenbaugh C, Antipatis VJ: **Obesity prevention: the case for action.** *Int J Obesity* 2002, **26**:425-436.
- Jakicic JM, Otto AD: **Physical activity considerations for the treatment and prevention of obesity.** *Am J Clin Nutr* 2005:226S-229S.
- Astrup A, Grunwald GK, Melanson EL, Saris WH, Hill JO: **The role of low-fat diets in body weight control: a meta-analysis of ad libitum dietary intervention studies.** *Int J Obesity* 2000, **24**:1545-1552.
- Astrup A, Buemann B, Flint A, Raben A: **Low-fat diets and energy balance: how does the evidence stand in 2002?** *Proc Nutr Soc* 2002, **61**:299-309.
- Rolls BJ: **The role of energy density in the overconsumption of fat.** *J Nutr* 2000:268S-271S.
- Yao M, Roberts SB: **Dietary energy density and weight regulation.** *Nutr Rev* 2001, **59**:247-258.
- Roberts SB, McCrory MA, Saltzman E: **The influence of dietary composition on energy intake and body weight.** *J Am Coll Nutr* 2002, **21**:140S-145S.
- Hill JO, Melanson EL, Wyatt HT: **Dietary fat intake and regulation of energy balance: implications for obesity.** *J Nutr* 2000, **130**:284S-288S.
- Howarth NC: **Dietary fiber and weight regulation.** *Nutr Rev* 2001, **59**:129-139.
- Howarth NC, Huang TTK, Roberts SB, McCrory MA: **Dietary Fiber and Fat Are Associated with Excess Weight in Young and Middle-Aged US Adults.** *J Am Diet Assoc* 2005, **105**:1365-1372.
- Slavin JL: **Dietary fiber and body weight.** *Nutrition* 2005, **21**:411-418.



31. Ludwig DS, Pereira MA, Kroenke CH, Hilner JE, Van Horn L, Slattery ML, Jacobs DR Jr: **Dietary fiber, weight gain, and cardiovascular disease risk factors in young adults.** *JAMA* 1999, **282**:1539-1546.
32. Ledikwe JH, Ello-Martin JA, Rolls BJ: **Portion sizes and the obesity epidemic.** *J Nutr* 2005, **135**:905-909.
33. McCrory MA, Suen VMM, Roberts SB: **Biobehavioral influences on energy intake and adult weight gain.** *J Nutr* 2002, **132**:3830S-3834S.
34. Wardle J, Parmenter K, Waller J: **Nutrition knowledge and food intake.** *Appetite* 2000, **34**:269.
35. Smith AT, Kuznesof S, Richardson DP, Seal CJ: **Behavioural, attitudinal and dietary responses to the consumption of whole-grain foods.** *Proceedings of the Nutrition Society* 2003, **62**:455.
36. O'Brien A, Fries E, Bowen D: **The effect of accuracy of perceptions of dietary-fat intake on perceived risk and intentions to change.** *J Behav Med* 2000, **23**:465-473.
37. Lechner L, Brug J, De Vries H: **Misconceptions of fruit and vegetable consumption: Differences between objective and subjective estimation of intake.** *Journal of Nutrition Education and Behavior* 1997, **29**:313.
38. Baranowski T, Cullen KW, Baranowski J: **Psychosocial correlates of dietary intake: Advancing dietary intervention.** *Annu Rev Nutr* 1999, **19**:17-40.
39. Brug J, Lechner L, Vries Hd: **Psychosocial determinants of fruit and vegetable consumption.** *Appetite* 1995, **25**:285-296.
40. Ronda G, Van Assema P, Brug J: **Stages of change, psychological factors and awareness of physical activity levels in The Netherlands.** *Health Promot Internation* 2001, **16**:305-314.
41. Kremers SPJ, Visscher TLS, Seidell JC, Van Mechelen W, Brug J: **Cognitive determinants of energy balance-related behaviours: Measurement issues.** *Sports Medicine* 2005, **35**:923.
42. Brug J, Glanz K, Kok G: **The relationship between self-efficacy, attitudes, intake compared to others, consumption, and stages of change related to fruit and vegetables.** *Am J Health Promot* 1997, **12**:25-30.
43. French SA, Story M, Jeffery RW: **Environmental influences on eating and physical activity.** *Annual Review of Public Health* 2001, **22**:309.
44. Krebs-Smith SM, Heimendinger J, Patterson BH, Subar AF, Kessler R, Pivonka E: **Psychosocial factors associated with fruit and vegetable consumption.** *American Journal of Health Promotion* 1995, **10**:98.
45. Rolls BJ, Morris EL, Roe LS: **Portion size of food affects energy intake in normal-weight and overweight men and women.** *Am J Clin Nutr* 2002, **76**:1207-1213.
46. Aarts H, Paulussen T, Schaalma H: **Physical exercise habit: on the conceptualization and formation of habitual health behaviours.** *Health Educ Res* 1997, **12**:363-374.
47. Kremers SPJ, de Bruijn GJ, Visscher TLS, van Mechelen W, de Vries NK, Brug J: **Environmental influences on energy balance-related behaviors: A dual-process view.** *International Journal of Behavioral Nutrition and Physical Activity* 2006, **3**.
48. Brug J, Oenema A, Campbell M: **Past, present, and future of computer-tailored nutrition education.** *Am J Clin Nutr* 2003, **77**:1028S-1034S.
49. Brug J, Campbell M, Van Assema P: **The application and impact of computer-generated personalized nutrition education: A review of the literature.** *Patient Educ Couns* 1999, **36**:145-156.
50. Stafleu A, Jansen-Van der Vliet M, Helmhout P: **Een intranetsite voor een gezond lichaamsgewicht.** *Voeding Nu* 2003, **5**:21-23. (in Dutch).
51. de Vries H, Mudde A: **Predicting stage transitions for smoking cessation applying the attitude – social influence – efficacy model.** *Psychology and Health* 1998, **13**:369-385.
52. Weinstein ND, Rothman AJ, Sutton SR: **Stage theories of health behaviour: Conceptual and methodological issues.** *Health Psychol* 1998, **17**:209-299.
53. Weinstein ND, Sandman PM: **A model of the precaution adoption process: evidence from home radon testing.** *Health Psychol* 1992, **11**:170-180.
54. Prochaska JO, Velicer WF: **The transtheoretical model of health behavior change.** *Am J Health Promot* 1997, **12**:38-43.
55. Verplanken B, Orbell S: **Reflections on past behavior: A self-report index of habit strength.** *Journal of Applied Social Psychology* 2003, **33**:1313-1330.
56. Feunekes G, Van Staveren W, De Vries J, Burema J, Hautvast J: **Relative and biomarker-based validity of a food-frequency questionnaire estimating intake of fats and cholesterol.** *Am J Clin Nutr* 1993, **58**:489-496.
57. Schuit AJ, Schouten EG, Westerterp KR, Saris WHM: **Validity of the physical activity scale for the elderly (PASE): According to energy expenditure assessed by the doubly labeled water method.** *Journal of Clinical Epidemiology* 1997, **50**:541-546.
58. Washburn RA, Smith KW, Jette AM, Janney CA: **The physical activity scale for the elderly (PASE): development and evaluation.** *J Clin Epidemiol* 1993, **46**:153-162.
59. Rogers EM: *Diffusion of innovations* 4th edition. New York: Free Press; 1995.
60. Brug J, Van Assema P: **Differences in use and impact of computer-tailored dietary fat-feedback according to stage of change and education.** *Appetite* 2000, **34**:285-293.
61. Nooyens ACJ, Visscher TLS, Jantine Schuit A, Van Rossum CTM, Monique Verschuren WM, Van Mechelen W, Seidell JC: **Effects of retirement on lifestyle in relation to changes in weight and waist circumference in Dutch men: A prospective study.** *Public Health Nutrition* 2005, **8**:1266.
62. Lean ME, Han TS, Morrison CE: **Waist circumference as a measure for indicating need for weight management.** *Brit Med J* 1995, **311**:158-161.
63. Seidell JC, Visscher TL: **Body weight and weight change and their health implications for the elderly.** *Eur J Clin Nutr* 2000, **54**:S33-S39.
64. Visscher TL, Seidell JC: **The public health impact of obesity.** *Annu Rev Public Health* 2001, **22**:355-375.
65. Vandelandotte C, De Bourdeaudhuij I, Sallis JF, Spittaels H, Brug J: **Efficacy of sequential or simultaneous interactive computer-tailored interventions for increasing physical activity and decreasing fat intake.** *Annals of Behavioral Medicine* 2005, **29**:138.
66. van Assema P, Brug J, Ronda G, Steenhuis I: **The relative validity of a short Dutch questionnaire as a means to categorize adults and adolescents to total and saturated fat intake.** *Journal of Human Nutrition and Dietetics* 2001, **14**:377-390.
67. Ocké MC, Bueno-de-Mesquita HB, Pols MA, Smit HA, van Staveren WA, Kromhout D: **The Dutch EPIC food frequency questionnaire. II. Relative validity and reproducibility for nutrients.** *Int J Epidemiol* 1997, **26**(Suppl 1):S49-S58.
68. Ocké MC, Bueno-de-Mesquita HB, Goddijn HE, Jansen A, Pols MA, van Staveren WA, Kromhout D: **The Dutch EPIC food frequency questionnaire. I. Description of the questionnaire, and relative validity and reproducibility for food groups.** *Int J Epidemiol* 1997, **26**(Suppl 1):S37-S48.

## Pre-publication history

The pre-publication history for this paper can be accessed here:

<http://www.biomedcentral.com/1471-2458/6/293/prepub>

Publish with **BioMed Central** and every scientist can read your work free of charge

"BioMed Central will be the most significant development for disseminating the results of biomedical research in our lifetime."

Sir Paul Nurse, Cancer Research UK

Your research papers will be:

- available free of charge to the entire biomedical community
- peer reviewed and published immediately upon acceptance
- cited in PubMed and archived on PubMed Central
- yours — you keep the copyright

Submit your manuscript here:  
[http://www.biomedcentral.com/info/publishing\\_adv.asp](http://www.biomedcentral.com/info/publishing_adv.asp)

